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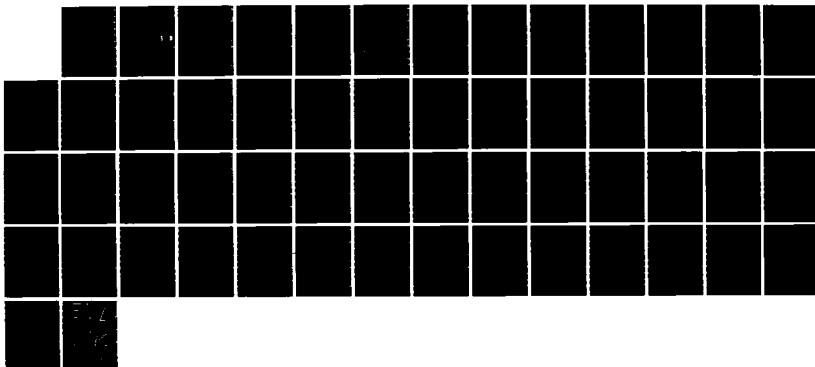
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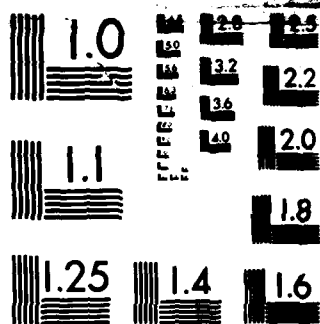
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A FIRST CUT AT DOCTRINE
FOR AUTOMATION OF DIVISION COMMAND AND CONTROL

by

Major Jerry W. McElwee
Signal Corps

School of Advanced Military Studies
U.S. Army Command and General Staff College
Fort Leavenworth, Kansas

2 December 1985

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Recommendations include:

- 1) Reduce the size of the current G3 staff organization.
- 2) Simplify G3 staff procedures.
- 3) Adopt a new command post concept with two separate command posts operating on twelve hour alternating periods.
- 4) Increase information available to the commander throughout the division area of operations.

The study concludes that the Combined Arms Center, as the lead proponent for automated support of command and control within the Army, should begin now to develop and test new doctrine for automated support of division command and control.

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ABSTRACT

A FIRST CUT AT DOCTRINE FOR AUTOMATION OF DIVISION COMMAND AND CONTROL

By Major Jerry W. McElwee, USA, 39 pages.

This study analyzes past efforts to introduce automated systems into existing military and civilian organizations. Six fundamental principles for successful implementation of automated support to management are derived and then applied to the U.S. Army division command and control system. Finally, modifications to current division staff organizations and procedures, division command posts and the commander's *modus operandi* are recommended.

The six principles for successful automation are:

- 1) Use information systems to improve internal communications and reduce analytical workload;
- 2) Minimize specialization of information workers;
- 3) Expand the jobs of information workers;
- 4) Simplify/modify organization structure before automating;
- 5) Encourage *agents of change*; *and*
- 6) Commanders and senior staff must provide a positive influence.

Recommendations include:

- 1) Reduce the size of the current G3 staff organization;
- 2) Simplify G3 staff procedures;
- 3) Adopt a new command post concept with two separate command posts operating on twelve hour, alternating periods; *and*
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The study concludes that the Combined Arms Center, as the lead proponent for automated support of command and control within the Army, should begin now to develop and test new doctrine for automated support of division command and control.

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1. INTRODUCTION:

"Knowledge and human power are synonymous"

Francis Bacon¹

The Army's involvement with automation began in 1943, with sponsorship of the development of the first electronic computer. Following the successful completion of that project two years later, the use of computers expanded into several areas, most notably command and control.² As evidenced by the world wide military Command and Control System (WWMCCS), there has been some success. However, in the realm of automated tactical command and control, the Army is barely out of the starting gate.

Even in the late 1950's, the senior Army leadership anticipated the speedy development and implementation of automated support to tactical command and control. For instance, MG James D. O'Connell, Chief Signal Officer, Department of the Army, wrote the following in February 1958:

On the battlefield of 1962, tactical commanders will have increased command control of their firepower and mobility through new communications and automation. The battle group commander will be able to use a small, mobile computer and associated parts of the automatic data processing system to calculate enemy concentrations, determine fallout patterns of friendly and enemy weapons, collate intelligence, calculate march tables, and perform other tasks. The company commander will have a supply of pocket size punchcards. Information placed on these cards and fed into the data system will be transmitted to battle group headquarters where it would be stored in electronic form in a memory component. Information or inquiries will be processed at battle group headquarters where commanders would use this data in reaching decisions.

Automatic data processing equipments at division level will consist of data recording and storage devices and small-capacity mobile computers. In contrast to the large and bulky commercial equipments used by industry, these will be small and light. Data introduced in

the division system will be transmitted to the mobile computers through the Area Communications System. This data will help the various commanders review the situation; it will help them analyze the probable results of various courses of action (both friendly and hostile) and thus will expedite decisions. The equipment will also be used to compile essential reports--daily personnel summaries, requisitions by units, strength reports, projections on a schedule basis--the mass and unwieldy flow of which have always been a problem to combat echelons. Similarly, the intelligence staff will be able to obtain current information more quickly. When essential data is not available at lower echelons, the processing unit can interrogate and obtain information from corps or army, or from an adjacent division. Requests for supplies can be consolidated and sent to appropriate supply points for action, thus largely eliminating the manual time-consuming aspects of this task.³

Clearly, the Army did not lack vision, just the ability to convert the vision into reality. Now, after almost 30 years, the Army is about to introduce a suite of equipments comparable to the system that MG O Connell described so prophetically at the beginning of the computer age. The Maneuver Control System (MCS) has been field tested on a limited basis in VII Corps and will be distributed to the rest of the Army beginning in 1985.⁴

Problem and Purpose

As the long-awaited day approaches, is the Army ready for MCS? Is the tactical command and control system properly organized to use this revolutionary new capability? Should command and control procedures change as a result of computer assistance? This paper will address the issues raised by these questions and provide some recommendations based on the arguments presented.

Command and control has been improving from its inception in prehistoric times. Man's first grunts, signs, and drawings were the forerunner of today's intricate command and control processes. From the spoken word distributed by especially trustworthy messengers, we evolved to the written word carried by

men (or animals, i.e. carrier pigeons) who could be relied upon to deliver the message. The sophistication of the message was no longer limited by the memory of the messenger but only by the writing and reading skills of the sender and receiver. With the introduction of electronic transmission media, the speed of command and control was increased dramatically. The telegraph restricted communications to areas it connected by wire, but the radio connected everyone within range of the transmitter.⁵

Today these communications systems are fundamental to the army's successful command and control of its units. In the past however, wire and radio were less useful. Introduction of new command and control technology into armies has normally been a difficult and sundering affair. During WW I, Allied commanders attempted to command from their command posts because that was where the telephone line terminated. Consequently, the commanders were not aware of the conditions faced by their men on the front lines and continued to commit them to almost certain slaughter as they assaulted from their trenches.⁶ On the German side, the difficulties of wartime communications in hostile territory bore no relationship to their peacetime exercise experience. Belgians cut telephone and telegraph wires; the powerful Eiffel Tower wireless station jammed the air waves so that messages came through so garbled they had to be repeated three or four times before sense could be made of them. The receiving station at the German field headquarters became so clogged that messages took from eight to twelve hours to get through. This was one of the frictions the German General Staff, misled by the ease of communications in war games, had not planned for.⁷

Fast experience in civilian industry and the military seems to indicate

that optimum use of the new equipment will require, perhaps, significant alterations to the status quo. Indeed, many civilian and military "experts" are claiming that an organization must be completely restructured in order to realize the full potential of the new information technology.⁸ Examining specifically the area of military command and control, one expert concluded from his analysis of the U.S. experience in Viet Nam and the Israeli experience in the 1973 Mideast conflict that, "...failures of command and control can be traced to unresolved institutional and organizational dilemmas in the G3 doctrine, brought about by failures in the organizational adaptation process to meet the new demands of a changed technological and political environment."⁹

There are currently no doctrinal or organizational changes planned to coincide with fielding of the MCS.¹⁰ Armywide issue of the MCS provides an opportunity to develop and implement basic doctrine for command and control using automated equipment. This basic doctrine will not necessarily supplant staff SOPs but it should standardize those procedures that will be endemic to all divisions. FM 101-5 provides the fundamental procedures for manual staff functions e.g. command procedures, estimate process, etc. The next step is development of the automated equivalent to FM 101-5.

II. THE DIVISION MANUAL COMMAND AND CONTROL SYSTEM.

On the eve of the introduction of a new technology to support command and control, an examination of the procedures and organizations that will probably be affected the most is in order. The total impact of tactical automation is incalculable, but its effects on the Division G3 staff, the commander and

division command post organization and structure can be estimated.

Assistant Chief of Staff for Operations

The division Assistant Chief of Staff for Operations (G3) has an extensive list of responsibilities that can be boiled down into four general areas: collect, analyze and present information on the current friendly situation of the division; recommend task organizations and priorities for allocation of resources to support the unit's mission; prepare and distribute plans and orders implementing the commander's decisions; and finally, monitor the execution of plans and orders, enemy responses, and change orders to subordinate units as necessary.¹¹

In today's manual command posts, information is collected in accordance with the unit SOPs which vary from one division to another. In general, subordinate units are required to submit periodic reports on information deemed necessary by the division headquarters. Exception reporting is required for those information items critical to successes of an operation, e.g. seizing an objective, suffering significant casualties, or finding too little or too much enemy resistance. The information collected is posted on map overlays and/or posted to status charts displayed in the current operations cell. As the information arrives, staff officers analyze it to determine the division's progress and to identify potential future problems which will require the commander's resolution. Because the reports from the subordinate units are periodic and since reports due to higher headquarters are also periodic, the work load in the current operations cell ebb and flows according to the report suspenses. In the absence of large deviations from the original plan, staff officers typically devote a majority of their time to monitoring, confirming,

or requesting reports from subordinate units until they reach the report cutoff time. They then begin preparing reports to their higher headquarters and/or a briefing to the division commander. There is also a considerable requirement for coordination among the different sections of the division staff, with the G3 staff normally being the central focus. This interaction is continual and involves the collection and correlation of information from all segments of the staff.

The G3 staff supports the commander's decision making process by providing estimates of projected friendly situations, analysis of courses of action based on information provided by the rest of the staff, and recommendations on allocation of resources. The basis for these assessments is the information collected from subordinate and higher units and the rest of the division staff. There are few, if any, doctrinal procedures which prescribe how the analysis should be done. In most divisions, the responsible staff officer establishes the mechanisms used or they are prescribed in a staff section SOP. Checklists are frequently used to insure that key steps or considerations are included in the analysis. The end product is designed to accommodate the requirements of the commander as he makes decisions regarding the future operations of the division.

Once a course of action is selected, the G3 staff is responsible for publishing and distributing the operations order to all units affected. The prescribed format for these orders started evolving during WW I and coalesced into its present form prior to WW II.¹² The five paragraph field order is written in the G3 section with input from the rest of the division staff. Annexes to the order are written in the appropriate staff section and appended

to the order before or after distribution. If time permits, the written order is typed and reproduced in sufficient copies for distribution by messenger to everyone with a need to know. This process can take as little as 12 hours or a number of days depending on the time available and complexity of the operation. When immediate action is required, verbal orders or teletype messages can be used to distribute orders.¹³

In addition to collecting information, preparing estimates and issuing orders, the G3 staff is also responsible for monitoring and synchronizing the current battle. In essence, the G3 current operations cell compresses the three previously described activities into a few minutes instead of hours or even days. Reallocation of Air Force aircraft sorties, reassignment of field artillery unit support relationships, and changes in unit task organizations are a few of the possible actions that the G3 staff may recommend to the commander for immediate implementation. For optimum concentration of combat power at the decisive time and place, the G3 must support the commander's synchronization of all the forces available to the division. When assumptions underlying the original plan are no longer applicable, the commander and G3 must respond in real-time to resynchronize the division.¹⁴

Division Commander

There are twenty-four versions of the division commander's role in command and control of a division--one for each active and reserve division commander. There are, however, a few constants. The commander normally goes to where he can influence the action, either forward at the battle or in the Division Main or Tactical (TAG) Command Post (CP). To influence the action, the commander

must have the most current and accurate information available. In many cases it comes from the commander's own observation of the battle or directly from the commander of the units in contact. He must also have the communications available to change or modify existing orders and to encourage their rapid execution.

Division Command Posts

The facilities portions of the division command and control system are the command posts. By doctrine there are three division level command posts: Division Main, Division TAC, and Division Rear. They respond to the division commander in providing continuous command and control of his forces. As in the role of the commander, the missions and functions of the three command posts vary dramatically between divisions. Doctrinally, the Main CP monitors the current battle and plans future operations, the TAC CP monitors and synchronizes the current battle, and the Rear CP plans the sustainment of the division. To survive, the Main and TAC CPs move frequently (at least once every 24 hours), use good operational security (OPSEC) to reduce their physical signature, and employ electronic security (ELSEC) to minimize their electromagnetic signature. They also operate from vehicles or buildings which provide a degree of protection from enemy artillery, tactical aircraft, and small arms fire. If either the Main or TAC CP is destroyed, the remaining CP assumes the full command and control mission of the division until the destroyed CP can be reconstituted. If both are out of action, the Rear CP or possibly a brigade CP can assume control of the division.¹⁵

III. NEW EQUIPMENT FOR TACTICAL COMMAND AND CONTROL.

In addition to fielding a new automated system for tactical command and control, the Army is also in the process of procuring four additional automated systems for air defense, combat service support, field artillery, and intelligence. The communications to support these automated systems and the voice requirements of the tactical army will be provided by three new communications systems. Unfortunately, the combat service support and air defense systems will not be fielded until after 1990 and consequently, are outside the scope of this paper. To fully understand the impact of the systems that will be available soon and to appreciate their interrelationships with MCS and the divisional command and control system, a brief description of each one is in order.

Maneuver Control System (MCS)

The MCS is a network of fully militarized and commercial computers linked by standard army communications systems. The data processing capabilities of the MCS devices, such as decision graphics, spread sheets, data base management, etc. are oriented to the needs of the G3 and his staff as they examine incoming messages and determine what information will require or cause the commander to take action. The MCS will expedite the identification of information desired by the commander and support his decision making process through graphic displays of timely and accurate information. Commanders can tailor the information provided by MCS to meet their specific needs based on mission, threat, organization, personnel, and the tactical situation. Information distribution is accomplished through the use of standard message formats. MCS operators select the format needed and fill in the required

information. Once a message has been transmitted and received, a system acknowledgement will be received automatically by the transmitting device. The information contained in the message is fed into the local data base either automatically or manually depending upon the commander's preference.¹⁶

All Source Analysis System (ASAS)

The All Source Analysis System (ASAS) is the automated system designed to support the G2 at corps and division. At the division, ASAS receives data from division intelligence collection systems, spot reports from units in the division, and intelligence from adjacent divisions and corps. The data and intelligence are stored, analyzed and converted into intelligence estimates by the Military Intelligence Battalion staff and division G2 staff. ASAS provides not only the data base capability, but also assists analysts in reducing the large quantities of data into useful intelligence. ASAS is linked via the division communications system with MCS at division and with the tactical fire direction system (TACFIRE) at Division Artillery Headquarters.¹⁷

Tactical Fire Direction System (TACFIRE)

TACFIRE was first fielded in 1977 after a ten year development cycle. The system performs the following fire-control functions: fire support coordination; keeping track of ammunition stocks and status of weapons; storage and application of meteorological data; fire-mission processing; and the computation and use of survey data. The system also provides a completely integrated communications system based on the current tactical communications systems. Using radio or land lines and high-speed line printers, a forward observer's request for fire can be processed by the computer, reviewed by the

battalion fire-direction officer and sent to the relevant battery in a few seconds time. At division level, the system can handle all tasks for up to 100 fire units, including naval gunfire and tactical air operations. It can store information on as many as 1,364 targets and display these according to as many as three standing requests. TACFIRE, MCS and ASAS will all have the capability of exchanging information and data over tactical communications systems.¹⁸

Mobile Subscriber Equipment (MSE)

New communications systems to support these automated systems will be in place in most divisions by 1990. Virtually the entire communications network in the division will be replaced with new equipment which uses state-of-the-art technology. The most radical change in division communications will be the Mobile Subscriber Equipment (MSE) now being procured from Thompson CSF of France through GTE. MSE will provide mobile telephone communications for the entire division down to maneuver battalion commanders. The Signal Battalion will install area communications nodes throughout the division area of operations which will connect to the mobile telephones in command posts or moving in vehicles. All communications links will provide secure voice and data capabilities to every user. Access to anyone served by the system is achieved by dialing their unique telephone number. The system then locates the desired party anywhere in the system and establishes communications.¹⁹

Position Location Reporting System (PLRS) Joint Tactical Information Distribution System (JTIDS) Hybrid (PJH)

Increased fielding of automated systems has increased the requirement for pure data communications systems. Hence, the Joint Tactical Information

Distribution System (JTIDS) was developed and will be fielded in 1988 to provide reliable and survivable high speed data communications between data terminals throughout a theater of operations.²⁰ A companion system, the Position Location Reporting System (PLRS), will be fielded with the JTIDS to provide limited data communications as well as position location information down to platoon level within a division. The combined systems are called the PLRS/JTIDS Hybrid or PJH. At division command posts, the PLRS portion of PJH will automatically provide MCS and ASAS with location data on units equipped with PLRS User Units, and allow limited data communications. JTIDS will link the division command posts with other headquarters which require high volume data communications, e.g. Military Intelligence Battalion Headquarters and Corps.²¹

Single Channel Ground and Air Radio System (SINGARS)

The last segment of the communications trilogy is the single channel radio. On March 27, 1899, a young scientist named Marconi successfully sent a message across the English Channel from Boulogne to Dover.²² Since then, single channel radios have continued to evolve and have revolutionized the command and control of military forces. Countermeasures against effective radio communications have also grown in sophistication and have reached the point that only computer controlled radios can reasonably expect to communicate effectively on the next battlefield. The latest development is the SINGARS radio. To avoid interception and jamming, the SINGARS changes frequencies rapidly during transmission. In a 10 second transmission, the radio will use almost 1000 different frequencies in a pseudo-random sequence; transmitting on any one frequency for less than 10 milli-seconds. In addition to avoiding

enemy efforts to disrupt communications, the new radio must also support data communications as well as voice.²³ Consequently, the developers have provided an error detection, error correction capability within the radio that can correct a message with one error in every ten characters to one with an error in every 1000 characters. Something that is virtually unreadable, can be corrected and used with confidence.²⁴

IV. FUNDAMENTAL AUTOMATION PRINCIPLES.

The business world and portions of the military have integrated automation into their management structures with mixed results. Lessons learned and fundamental principles derived from these efforts are applicable to automation of division tactical command and control.

Internal Communications and Data Analysis

Historically, as an organization evolved in complexity and the environment became more uncertain, the hierarchical organization of the firm added new managerial functions. In keeping with the concepts of individual efficiency so deeply rooted in the thought patterns of industrial-age management, new staffs were added in narrow areas of specialization.²⁵

At the beginning of the industrial revolution, commerce was characterized by small one man or family businesses. The owner was the manager and primary worker. All of his employees were actually engaged in producing the product he sold for profit. As production efficiencies improved, and as transportation developed, opening up larger markets for products, the manufacturer increased his output and hired not only more workers but also intermediate supervisors

and specialists such as lawyers and accountants to help with the management of the additional workers and to deal with his customers. The owner's goals were increased output at lower cost; he perceived, correctly, that more supervisors were required to keep his span of control within reasonable limits. The classic example is Henry Ford and the growth of the automobile industry from a garage to a multi-billion dollar industry in less than 100 years. This phenomenal growth has been realized by the addition of "information workers" to production workers. The ratio of information or white collar workers to production or blue collar workers has been increasing steadily since the mid 1800's and is currently over 56% of the total work force. By the year 2000, some experts predict that information workers will total nearly 70% of the work force.²⁶

The information worker collects and analyzes information, makes decisions or provides analyzed information to his superior for decision, and then distributes information to maintain or improve the effectiveness of the organization in producing a product and providing a service to its customers. Information workers may deal with acquisition of resources, production and delivery of a product, or with customers and marketing of the product. As a result of his effort, the information worker theoretically improves the profits of the organization or provides other intangibles which add future benefits to the organization. Fundamentally, he processes information.

Examination of the total information flowing in an organization provides surprising results. In a survey of information flow within several large product oriented organizations, 93% of the information flow was internal to the organization, i.e. it was originated and terminated by people in the company.

Only 10% of the information was new. The rest of it was simply reformatted or analyzed information that had been congealed for consumption by other information workers. Information flowing out of the organization was less than 6% of the total information.²⁷

Staffs are the information workers of the military and the Army has experienced increases in organizational structure, specialization and information flow similar to those in the business community. For example, in 1917, the U.S. Army Division Staff had approximately 20 people with only an officer and part time enlisted man in the G3 section. By 1945, the G3 section had grown to 12 personnel with the addition of specialists for training and education, air operations, and clerical support.²⁸ In 1960, an Infantry Division still had 12 people in the G3 section.²⁹ By 1963, the G3 section had grown to 19 people and remained there for several years.³⁰ However, in development of Division 86 organizations, the G3 section in the Light Infantry Division has grown to 36 personnel with 39 in the Heavy Division.³¹ The addition of specialists from virtually every officer branch is the major cause of the large increase in size. Comparable growths have occurred in other staff sections as well, although they are not quite as spectacular as those of the G3. As expected, communications requirements have kept pace with the growth in staff sizes.

Since 1960, the Army has continued to field new communications systems with ever increasing capacity to support the stated needs of the tactical forces. As the new communications systems near their fielding dates, there is considerable concern in the combat developments community that they will be insufficient to handle the total communications requirement. The unofficial

campaign slogan in the combat development community is, "We must de-appetize the system."³²

The cause of this growth is the increasing diversity and specialization of operational units such as artillery, intelligence, communications, air defense, tactical aircraft and others. To overcome this problem, top commanders have expanded their staffs to include the necessary expertise for effective utilization of the assets available to them. As a result, staffs have increased in size and a larger share of the commander's attention span during combat is directed to internal communications within his command post and the specialists and expert interpreters of the information received from the front.³³

The paradox for both civilian and military organizations is that as their management structures grow to handle the increasing diversity of the organization, the internal information flow increases exponentially and the management structure becomes less efficient and less effective. A phenomenon described as "information overload" may then occur at some levels in the organization and exacerbate management problems by forcing supervisors to make decisions with too much information that has not been analyzed and reduced to a digestible form. The result is often irrational decisions, psychologically impaired information workers and increasingly inefficient and ineffective organizations.³⁴ The solution to this has been the introduction of information systems that make more information more readily available to larger segments of the organization. In many cases, they also assist in analysis and correlation of data and synthesis of the information, thus relieving a portion of the information worker's burden. These information systems not only provide

storage and retrieval of information, but, coupled with communications systems, provide superior internal communications between information workers.³⁵ Recent case studies confirm this view and indicate that the most beneficial results of integrating an information system into an organizational structure are the improved intragroup communications. However, these benefits occur only if the various work stations throughout the organization are connected together in a communications network.³⁶ From the above discussion is derived the first principle for employment of automation:

1st Principle:

Information systems should improve internal communications and reduce the analytical workload of information workers by aiding in the analysis and correlation of data and synthesis of information to support decision making.

Reduce Specialization

The other aspect of expanding organizational diversity, alluded to earlier, is the increase in specialization of information workers. Job design based on excessive specialization is a major cause of unproductive information-handling work. If the specialist can be converted into a generalist capable of handling a greater variety of functions, supervisors and administrators can be given jobs that contribute to organizational effectiveness rather than add to overhead.

Industrial engineering techniques measure efficiency to determine the value of changes to an organization. However, with information systems, a more useful criterion is that of organizational effectiveness, which includes, but

is not subsumed, under the category of efficiency. Efficiency is an individualistic category that is often meaningless when applied to larger groups; effectiveness is a matter of team performance and is the critical measure.³⁷

Extracting an example from the military, in the mid 1970's a Corps commander in Europe wrote a blistering condemnation of the "tyranny of the message center". To summarize the problem, messages in and out of the corps headquarters all went through the message center. There were a total of eight to ten steps in getting a message in or out. First a messenger picked up the message from the staff section and delivered it to the message center logging each message picked up and delivered. At the message center, a log-in clerk signed for the message, checked it for completeness, and then passed it to a routing clerk. The routing clerk checked the addresses and determined the best message routing for each addressee. The message then went to the "poker" who actually typed the message onto a paper tape in preparation for transmission. The paper tape from the poker, along with a paper copy of the message, then went to the teletype operator or operators for actual transmission to each addressee. After transmission of the message, the teletype operator waited for an acknowledgement or request for retransmission of part or all of the message. Depending on the quality of the circuits and length of the message, it could take as long as 20 to 30 minutes to send a single message. After the message receipt was confirmed, the teletype operator returned the tape and paper copy of the transmitted message to the records clerk for filing. If the message center was unable to deliver a message after a specified period of time, it returned the message to the originator. Each component of the message center

was extremely efficient; a message seldom spent more than a few minutes in each section. However, the overall effectiveness of the message center was poor. The average time to actually get a message out of the headquarters to the addressee often took days instead of minutes or hours as it should. This leads to the second principle.

2nd Principle:

Organizations supported with information systems should minimize specialization of information workers to increase unit effectiveness.

Job Expansion

Experience in the business community indicates that introduction of information systems into an organization changes the nature of work done by information workers. At the clerical level, work becomes less routine. A clerk typist is freed from the repeated typing of the same document and expands into other areas, possibly, collection of information required for the documents they produce. Over two thirds of the contemporary manager's time is expended in passing intra-organization information to others. Today most of these tasks can be performed much better through computer networks. The role of the manager as a coordinator and as an information intermediary will largely disappear; in its place the manager will assume the role of resource allocator.³⁸ The following case study illustrates the job expansion possibilities.

A regional patent attorney office purchased an information system and carefully documented the "before and after" impact on the functioning of the office. Each attorney in the office, as well as all of the secretaries,

received work stations connected to a central processor that allowed sharing of working files and provided an electronic mail capability. With the new system, attorneys collected initial information from their clients and entered it into the workstation on their desk. The data was then accessed by the secretary who typed the necessary documents for distribution and filing. A surprising effect was the reduction of incoming and outgoing telephone calls. Because of the improved predictability of information requirements from applicants and improved efficiency of the office, information was initially collected more completely and then processed in a more timely fashion. Incoming queries for status were reduced by 45% and outgoing requests for additional information were reduced by 27%. The length of meetings was not affected, however, the subjects discussed changed from status of pending actions to recent rulings on patent law and the potential impacts. In essence, meetings became an opportunity for sharing professional information rather than acrimonious reviews of ongoing projects. The secretaries in the office spent considerably less time revising documents and more time handling telephone calls. Typing output doubled and required less time. Job satisfaction of the secretaries also increased because their work expanded in scope and they perceived that they were making a greater contribution to the successful operation of the office. The attorneys were also affected. With the improved efficiency of the secretaries and use of their own workstation, they became 11% more efficient and were able to provide better support to their clients. Finally, in the manual office there were over 40 individual steps required to completely process a patent application. With the automated system, application procedures were streamlined and fourteen of those steps were no longer required.³⁹ To summarize into one principle:

3rd Principle:

Information systems should upgrade the jobs of clerical and technical personnel to generalists, expand the role of the middle manager to include resource allocation and allow senior management to concentrate on long range planning.

Organizational Restructuring

From the previous principle, information systems should be used to improve effectiveness not efficiency. It therefore follows that office automation should be attempted only after work has been simplified to enhance overall operations of the organization. Productivity is improved by simplifying organizations, not by speeding up work with a computer.⁴⁰ This fact has been recognized by the business community which is beginning to redesign their organizations from the ground up with the capabilities of the computer as the basis for the restructuring.⁴² Optimum use of information technology requires modification of the organizational structure or a complete redesign.

Military history is replete with failures to recognize reorganizational requirements inherent in adoption of new technology. Based on an analysis of the U.S. experiences in Viet Nam and the 1973 Arab-Israeli War, Mr. Raanan Gissin reached similar conclusions concerning command and control.

For any combat organization,...the effective execution of the generic control and communications functions can be viewed as determined by the degree of compatibility between the manner in which the technological capabilities are being used and the organizational-institutional aspects of the doctrine.⁴²

The principle extracted from this discussion is:

4th Principle:

Organizational structure must be simplified/modified before it can be effectively automated.

User Acceptance

The greatest cost of automation, at least in a civilian business, is installation, not design. Gaining user acceptance, providing adequate training and ongoing support far exceed initial costs of design and procurement. Consequently, these areas should receive the greatest emphasis.⁴³

In an article published in the March 1983 Military Review, General Donn Starry identified several requirements to produce changes. Among them was the need for a spokesman for change, perhaps a "maverick" who could develop a positive consensus about the proposed modifications.⁴⁴

Experts in information technology have reached similar conclusions about successful implementation their systems. Successful adoption of information technology requires agents of change--high-performance individuals--who lead an organization in accepting a transformed workplace.⁴⁵ Information system design seldom addresses all of the problems faced by information workers in their daily routine. Consequently, when the new equipment arrives, well trained users, enthusiastic about finding better ways to do their jobs, will begin exploring the capabilities of the new equipment. These agents of change are essential in gaining acceptance of the new technology and in expanding the use of the system into other areas. However, if an information system is

inflexible and not "user-friendly", it will quickly discourage new users and acceptance of the system will take much longer.⁴⁶

5th Principle:

Successful introduction of information technology to an organization requires extensive user training, flexible system design and, most importantly, "agents of change" who will adapt the new system to a variety of tasks.

Command (Senior Management) Influence

After user acceptance, the most important factor required for implementation of information technology is senior management involvement in all phases of the design and use of the installed system. The senior executive is the key to linking information technology investments with the goals of the enterprise. This linkage cannot be compromised or delegated if the full potential for productivity is to be realized.⁴⁷

The Army's efforts in developing and fielding new technologies corroborates the civilian experience. In the late 1960s, the Army was developing automated systems for command and control with minimal success. The biggest problem was getting the Army to agree on just what the automated systems would do. Three senior managers in the Department of Defense have commented on the problem. Dr. Eugene Fubini, the former Deputy Secretary of Defense for Research and Engineering wrote in July 1965:

The major problem today in the design of a command and control system is how to bring the commander and staff into the decision-making system.⁴⁸

At the about the same time, Mr James Bridges, a special assistant to Dr. Fubini for command and control, expounded on the same problem:

The heart of the obstacle to command and control progress has been leaving the commander out. The technician would develop a system and present it to the commander, the commander's response would be, "That's fine, but I do not want that kind of system."⁴⁹

Finally, in a speech at the Army War College in June 1982, General Donn Starry stated that one of the criteria for change in a organization was:

Someone at or near the top of the institution must be willing to hear out arguments for change, agree to the need, embrace the new operational concepts and become at least a supporter, if not a champion, of the cause for change.⁵⁰

Clearly, an underlying principle for successful implementation of a new technology is:

6th Principle:

The commander and senior staff must be intimately involved in design and use of new information systems.

These six principles were derived from lessons learned in the business community and within the military as they wrestled with design and implementation of information technologies to improve the management of their primary functions. The next step is to apply these lessons learned to the pending field deployment of the Maneuver Control System and its associated information and communications systems.

V. APPLICATION OF PRINCIPLES TO DIVISION COMMAND AND CONTROL.

The specific portions of the division manual command and control system described above will now be examined in light of the derived principles and new

equipment capabilities. Shortfalls in personnel, organization, and doctrine will be identified and recommendations for correction will be presented.

Information Collection, Analysis, Display

The division G3 and his staff are responsible for collection, analysis and presentation of information. Sources of information include subordinate units, higher headquarters and adjacent divisions. The information will come specifically from MCS, TACFIRE, ASAS, and messages received manually from units not equipped with an automated system. Information will be transmitted via MSE, SINGARS, PJH or by messenger. The G3 staff will maintain a central data base in the MCS and update it with new information as it arrives at the current operations cell. Routine examination of the information will be performed continuously. More detailed analyses will be performed when requested by the commander, when an underlying assumption of a current or planned operation is no longer correct, or when the "coup d'oeil" of the staff officer indicates that more analysis is required. Formatting and displaying the analyzed information will be done automatically by MCS based on the preferences of the commander. (Product improved versions of MCS, to be fielded before 1990, will include a video graphics system which will eliminate the requirement to post and update unit location information on large map overlays.)

The two functions requiring G3 staff support are collection of information and analysis. Collection of information can be subdivided into answering radio and telephone calls, deciding what information received on MCS can be included in the data base, entering manually received messages into the MCS data base, identifying and requesting missing information, and assessing received

information for accuracy. Analysis is primarily a comparison of the status of current operations with expected results and prediction of future conditions based on presumed actions of both friendly and enemy forces.

Qualifications of personnel currently performing these functions are varied. Generally, the message takers are lower ranking enlisted personnel with a communications specialty or training. Clearly, taking down radio and telephone messages is a lower skill function which requires good ears, an understanding of how the communications equipment is operated, and some ability to determine what action is required in response to each message, e.g. who needs to see it next.

Applying the second and third principles to this job, i.e. reduce specialization and expand worker's responsibilities, indicates that changes are required. First, this job can easily be expanded to include entering messages into the data base and assuming full responsibility for the contents of the data base. Judgment on what MCS information should be entered into the data base requires an understanding of current and future operations, an appreciation for events or actions that can disrupt operations and the ability to identify questionable data. The manual corollary of this function is performed by a G3 staff officer or the operations NCO as he determines what information is used to update status charts posted in the current operations cell. Therefore, the skills to perform this function in an automated command post are best provided by a G3 staff officer or the operations NCO.

Experience with TACFIRE corroborates the above statements. If the commander was not very clear about delegation of authority, he often found that the TACFIRE operator was controlling the unit. The extent to which the

commander delegated authority to act on routine matters was much greater for automated command and control systems than for manual equipment.51

Entering data received manually into the MCS data base requires less skill. However, the information must be reviewed for relevancy and will therefore require at least a review by a G3 staff officer or operations NCO prior to entry. Until all data is received through MCS or some other information system, this function may require the assistance of lower ranking enlisted personnel because of the potentially large quantity of messages. If there are three or more workstations in the current operations cell, a junior enlisted person can manually enter data for final review by the officer or NCO.

Identifying and requesting missing but required data pertinent to current and future operations can be done by a senior NCO or officer in the G3 operations section. The other half of this function is providing missing information to higher, adjacent and lower units. Invariably, someone will call the G3 current operations cell to request verification of status, report a critical event, or to request some immediate action. In many instances, the caller will insist upon talking to the senior person in the cell. Hence, a senior NCO or G3 staff officer must be available to perform this function.

Assessing received information for accuracy is done by everyone who reads the message. The radio or telephone operator almost automatically checks for completeness and gives it the "make sense" test. The G3 staff officer does the same thing before entering information into the MCS data base. Therefore, an additional individual is not required for this task.

Analysis of information is a function of the G3 staff officer, operations

NCO, or in some cases the G3. In addition to fully understanding current operations and the assumptions upon which they are based, the analyst must know how the various components of the division force structure interoperate in different combinations of mission, enemy, terrain, troops and time (METT-T). He must also have access to the MCS data base, to information contained in other staff sections, and to information contained in ASAS and TACFIRE, if it is not readily accessible through MCS. Finally, he must be able to share working files and exchange electronic mail with other staff officers at higher, lower and adjacent headquarters. Successful performance of this function by one individual is dependent upon the improved communications and preliminary analysis promised by the first principle. If the MCS is not used to improve internal communications of vital information and to perform some preliminary analysis of the data, the G3 staff officer will be overwhelmed. Information overload and its attendant problems will consume not only the G3 but possibly the rest of the staff.

In summary, to perform the information collection, analysis and presentation function, the G3 staff requires an enlisted radio telephone operator to receive and transmit messages manually, a G3 staff officer or operations officer who is responsible for maintaining the MCS data base and identifying and obtaining missing but required information, and an officer to perform the necessary analysis. The minimum requirement is one officer, a senior NCO and an enlisted person for a 12 hour shift, not including the G3.

G3 Support to the Commander's Decision

MCS has the potential to significantly alter the operating procedures and

organization of the division G3 plans section, more so than in any other element of the staff. The latest command and control doctrine has 27 personnel in the division G3 Plans cell, 25 of which come from the G3. There are nine majors, five captains, eight senior enlisted and five junior enlisted personnel (includes a five person deception cell).⁵² MCS can effectively eliminate a significant number of these people when the first four principles are applied to the plans function, i.e. improve communications and analysis, reduce specialization, expand jobs, and reorganize.

G3 staff support to the commander's decision making process requires development and analysis of possible courses of action which will support accomplishment of the division mission. Based on the commander's restatement of the division mission, coordination with Corps staff, and information in the MCS data base, the G3 plans officer will formulate very general and tentative courses of action. They will then be provided to the rest of the division staff, through the MCS, for coordination and expert analysis. Clarification of details concerning a course of action can be done over the telephone or via the MCS and electronic mail, if the person with the answer is not available by telephone. Electronic mail is probably preferable in most cases because it allows everyone access to the questions and answers rather than just the two people involved on a normal telephone conversation.

As the various staff sections complete their analyses, they provide their responses to G3 plans via the MCS. The G3 plans officer reviews staff comments as they arrive and finalizes the details on each viable course of action to be presented to the commander for decision. The completed courses of action are then evaluated by each staff section in accordance with a set of criteria

determined by division SOP or by the commander. Finally, results of the evaluation and the courses of action are presented to the commander, G3, and other staff officers for review and a decision.

The improved internal communications allow dispersal of the division detailed planning function throughout the other staff sections instead of aggregating experts from several disciplines within the G3 Plans. For example, the Fire Support Annex can be more easily prepared in the Fire Support Element (FSE) than in the G3 Plans cell. The fire support experts have access to TACFIRE terminals in the FSE and are surrounded by the current and predicted status of fire support systems available to the division. On the other hand, if fire support specialists reside in the G3 Plans cell, they would be available for the initial formulation of courses of action but would be constantly referring to the FSE for confirmation of supportability for each alternative. G3 planning would be perceived as more efficient, but it would, in reality, be less effective for the division as a whole. The key fact is that MCS supports the give and take communications needed to formulate and develop courses of action.

This organization also minimizes the number of specialists on the division staff. Centralizing the required experts in one area reduces the overall number required. The jobs of the division staff are also expanded. Not only does the G3 Plans officer become more of a generalist, but the other staff sections become involved in the planning function as well as current operations, thus expanding their jobs. Organizational design is simplified because there are fewer specialists and more direct communications. The total G3 planning function can now be orchestrated by an officer and senior NCO with

the support of specialists in other staff sections. The Air Defense Artillery, Engineer, Logistics, Fire Support, Intelligence, Counter Intelligence, and Electronic Warfare Officers and their NCOs can be deleted from the G3 section of the TOE and returned to their original staff sections or eliminated. If more than two planning coordinators are required, they should be generalists rather than specialists.

Distribution of Plans and Orders

Preparation and distribution of orders and plans is generally a function of the G3 plans section. The G3 current operations section handles the preparation and distribution of frag (fragmentary) orders. Once the commander has selected a course of action, the G3 plans officer will transform it into an operations plan or order. The improved internal communications capabilities provided by MCS virtually eliminate the large amount of manual labor currently required.

The following sequence of steps will normally be followed by the G3 plans officer and will be implemented via the MCS: distribute the commander's decision(s) to the division staff, task each staff element to write their portion of the order for consolidation, write the G3 portion of the order, and finally, integrate the paragraphs and annexes from the rest of the staff into a complete order or plan. The completed plan or order is then provided to the G3 and other senior staff officers for final approval. Once approved, the order is distributed through the MCS or the division messenger system. Fundamental to the entire process is the reliance on electronic mail and the sharing of files in the MCS. Written documents are not manually duplicated, nor are they manually transported between staff sections. This function is a logical

extension of the G3 plans section's preparation of estimates and courses of actions and no additional personnel are required.

Synchronization of the Current Battle

The final G3 function to be examined is the coordination and synchronization of the current battle. As part of the information collection, analysis and display function, there is an additional responsibility to modify existing orders as necessary to enhance accomplishment of the division mission. The G3 staff officer in the division current operations cell constantly compares the information being collected with the assumptions and conditions required for successful mission completion. As conditions change, he identifies and recommends actions that will get the division back on track to successful mission completion.

Effective synchronization is dependent upon the first principle of information systems implementation: i.e. automation provides improved internal communications and some data synthesis. MCS is essential to the G3 operations officer in performing the following specific actions: coordination with other staff sections and/or units to determine feasible alternatives or mission changes, short analyses of alternative courses of action, presentation of information and courses of action to the appropriate decision maker, distribution of the decision to the rest of the staff, coordination of the pending order with units affected to include higher, lower and adjacent units, and finally, issuance of the frag order. The procedures and techniques used by the G3 staff officer are similar to those used by the plans officer to gain staff consensus and evaluation of courses of action. The only difference is

that he coordinates the modification of an existing order in a very compressed time frame instead of developing a new order over a longer time span. No additional personnel are required for this function since it is an extension of the G3 operations officer's responsibilities for collecting and analyzing information.

Summarizing, the minimum G3 manpower requirement for a single 12 hour shift in the Division Main CP is five people. A G3 operations officer, operations NCO and radio telephone operator are required in the current operations cell and a G3 officer and NCO work in the plans cell. The G3 is additional to the five required personnel. (This analysis of the G3 staff personnel requirement is based entirely on historical lessons learned and will require extensive testing with MCS and its associated equipment before it can be implemented.)

Commander's Modus Operandi

Moving from the functions and operation of the G3 to the modus operandi of the commander. MCS and the newly developed command and control systems provide the opportunity for major alterations to the commander's methods of command and control. The commander performs two basic functions: command and control of his forces and leadership of his subordinates. Command and control includes the collection and analysis of information through personal observation and from his subordinates, both staff and commanders. Based on that information, he decides on the actions to be taken by the division and then monitors key components of his plans to assess progress and modifies them as necessary. Leadership of subordinates is accomplished uniquely by each commander. Since the most effective leadership techniques require direct contact with the subordinates, most commanders spend much of their time in the field with their

forces.

To effectively command and control his division, the commander must have nearly constant access to information on the current operations of the division. When he perceives a need to change some portion of an existing order, he must review the current operational status, analyze alternative courses of action and, preferably, consider the comments of his staff and subordinate commanders. The MCS, coupled with PJH, MSE and/or SINGARS will provide him with that capability as established by the first principle. It will not however, give him the feel of the battlefield nor the face-to-face communications with the key players in a particular action. For these he must go to the scene of the battle or that place where he can best absorb the tempo and direction of the activity he wishes to affect. If it is impossible for him to move to the scene of the action, he must send a trusted observer or rely on written or oral reports of observers already there.

The second function of the commander is the moral leadership of the forces entrusted to his command. Several U.S. Army leaders from WW II and other more recent conflicts have stated that being present and seen by the troops fighting the critical battle, either before or during the action, was often instrumental to the success of the operation. There are countless examples of senior leaders appearing on the scene in critical moments and rallying their troops to renewed efforts.⁵³ MCS contributes indirectly to the motivation of the division by freeing the commander to move around the battlefield without losing sight of the total picture.

General Matthew Ridgway emphasized the importance of command and control

and personal leadership in his October 1966 article entitled "Leadership".

As commander of a division or smaller unit, there will rarely be more than one crisis, one really critical situation facing you at any one time. The commander belongs right at that spot, not at some rear command post. He should be there before the crisis erupts, if possible. If it is not possible, then he should be there as soon as he can after it develops. Once there, then by personal observation of terrain, enemy fires, reactions, and attitudes of his own commanders on the spot -- by his eyes, ears, brain, nose, and his sixth sense -- he gets the best possible picture of what is happening and can best exercise his troop leadership and the full authority of his command. He can start help of every kind to his hard-pressed subordinates...⁵⁴

MCS and the associated communications equipment allow the commander to conform to General Ridgway's guidance. It will give the commander almost continuous access to his staff and subordinate commanders wherever he goes. He will have pictorial displays of the division status to include location and combat strength of units down to battalion level. He will have voice and data communications with his staff and all of his commanders and their staffs down to battalion level. If necessary, he can use SINCGARS to reach front line troops. His options for commanding and controlling the division are therefore significantly expanded. He is no longer required to return to the Main or TAC CP in order to plan for future battles. The most current information about ongoing division operations will be constantly available to him. In this environment, the commander may concentrate on influencing the battle at the critical time and place rather than on planning the next operation. Certainly, he will frequently want to return to the Main CP to talk directly with his staff, but that may now be done at his convenience rather than every time a decision is required.

Command Posts

Historically, command posts have been the tactical home of the commander and his staff. The commander spent a portion of each day travelling around the battlefield and the remaining time in the command post working with the staff. MCS and the new communications systems will allow a reduction of the time the commander spends in his CP. The staff, however, will continue to require well protected working space. The survivability of the CPs is based on frequent moves and good OPSEC and ELSEC. If either the Main or TAC CP is located, targeted, and damaged, the other CP assumes the full command and control function of the division until the damaged CP can be reconstituted. Both CPs are operational on a 24 hour basis.

An alternative command post concept is made possible by the enhanced communications and information management capabilities of MCS and its associated communications. The concept maintains continuous command and control with two command posts that alternate control of the division between them, but which need not be fully operational on a 24 hour basis. After a 10 - 14 hour period, one command post will shift control of the division to the alternate and then move to a new location. Once communications are reestablished, the majority of the staff will go to sleep. The MCS data base at the sleeping CP will continue to receive new information as directed from the operational CP. At the end of the sleep period or when ordered to resume command, the staff officers activate their CP, review changes in status since they were last active, and clarify any questions about status or current operations. Once updated, control is shifted and the other CP goes into its move/sleep cycle. If a CP is damaged and unable to continue controlling the

division, the other CP assumes control immediately and continues operations on a 24 hour basis until the damage is repaired or the alternate is reconstituted with equipment and personnel. When the surviving CP must move or shut down temporarily, Division Rear or a brigade CP can assume the division control function, although its staff will require augmentation to control the division for extended periods of time.

The above CP concept reduces personnel and equipment required to control the division. The current Main CP staff is reduced and split into two sections and equipped with identical equipment. The TAC CP personnel are eliminated and their equipment is used by the second shift Main CP. The equipment savings are realized in the reduced signal assemblages required to support the Main and TAC CPs. While the commander is away from the CP, his vehicle and associated MCS and communications equipment also provide a limited capability to assume control of the division.

Implementation

In any human endeavor, resistance to change by the individuals to be affected often frustrates altogether the efforts of the advocates for modernization.⁵⁵ As detailed in the fifth and sixth principles, the key factors in successful fielding of MCS are commander involvement and encouragement of "agents of change". The commander and his senior staff must provide the command emphasis to insure that MCS is used to its fullest extent both inarrison and in the field. When MCS is fielded, agents of change will begin experimenting with the hardware and software to find out what its limits are and how it can be expanded to do more of their jobs faster and simpler. They must be encouraged by their supervisors and allowed to "waste" a lot of

time "playing" with MCS. Formal training is required, but it is what happens after the training that is most important.

VI. CONCLUSIONS:

A young Israeli student captures the theme of this paper in a summary statement written in his doctoral dissertation dealing with the introduction of new technology into military forces and the impact it had on the U.S. in Vietnam and on the Israelis in the 1973 Mideast conflict:

The most sophisticated C3 technology may be of no help or might even degrade combat effectiveness if it is superimposed over a command and control doctrine and structure that does not provide the organizational flexibility and adaptability to make effective use of the new C3 capabilities. On the other hand, a flexible command and control doctrine that is consistently held by all echelons in the chain of command, and which allows the accomplishment of the communications and control process without adversely affecting the command prerogatives of combat echelons, is likely to foster an operational philosophy that would allow effective adaptation to the changes brought about by the technology.⁵⁶

This paper has endeavored to distill from prior military and civilian experiences the fundamental principles for use of information systems in tactical command and control. These principles were then applied to the division G3 section, the division commanders modus operandi, and finally to the command post concept. Obviously, a more complete effort would have addressed the entire division staff if not the total division command and control structure. Unfortunately, development of a new organization and doctrine for division automated command and control is well outside the prescribed limits of this paper. The six fundamental principles should, however, be used as guidelines in restructuring division command and control with the introduction of information systems. They are restated below as imperatives for effective

implementation of information technology.

Use information systems to improve internal communications and reduce analytical workload.

Minimize specialization of information workers.

Expand the jobs of information workers.

Simplify/modify organization structure before automating.

Encourage "agents of change".

Commanders and senior staff must provide a positive influence.

Restating the problem, there is no doctrine for use of MCS in command and control of a division. The current command and control doctrine is based on an entirely manual system. The operational and organization concept for MCS does not address new doctrine and, in fact, emphasizes that MCS will not require changes to the current division organization. If it is fielded without some effort to develop automated command and control procedures and without reorganizing information workers, it will languish in the CP, used for only those functions now performed manually. The full benefits of information technology will not be realized to the detriment of the Army. For effective integration of MCS, ASAS, TACFIRE and the other automated systems being fielded in the next few years, the Combined Arms Center, at Fort Leavenworth, must begin now to develop and test the procedures staff officers will use in collecting and analyzing information, preparing estimates, and preparing and evaluating courses of actions for the commander's decision.

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